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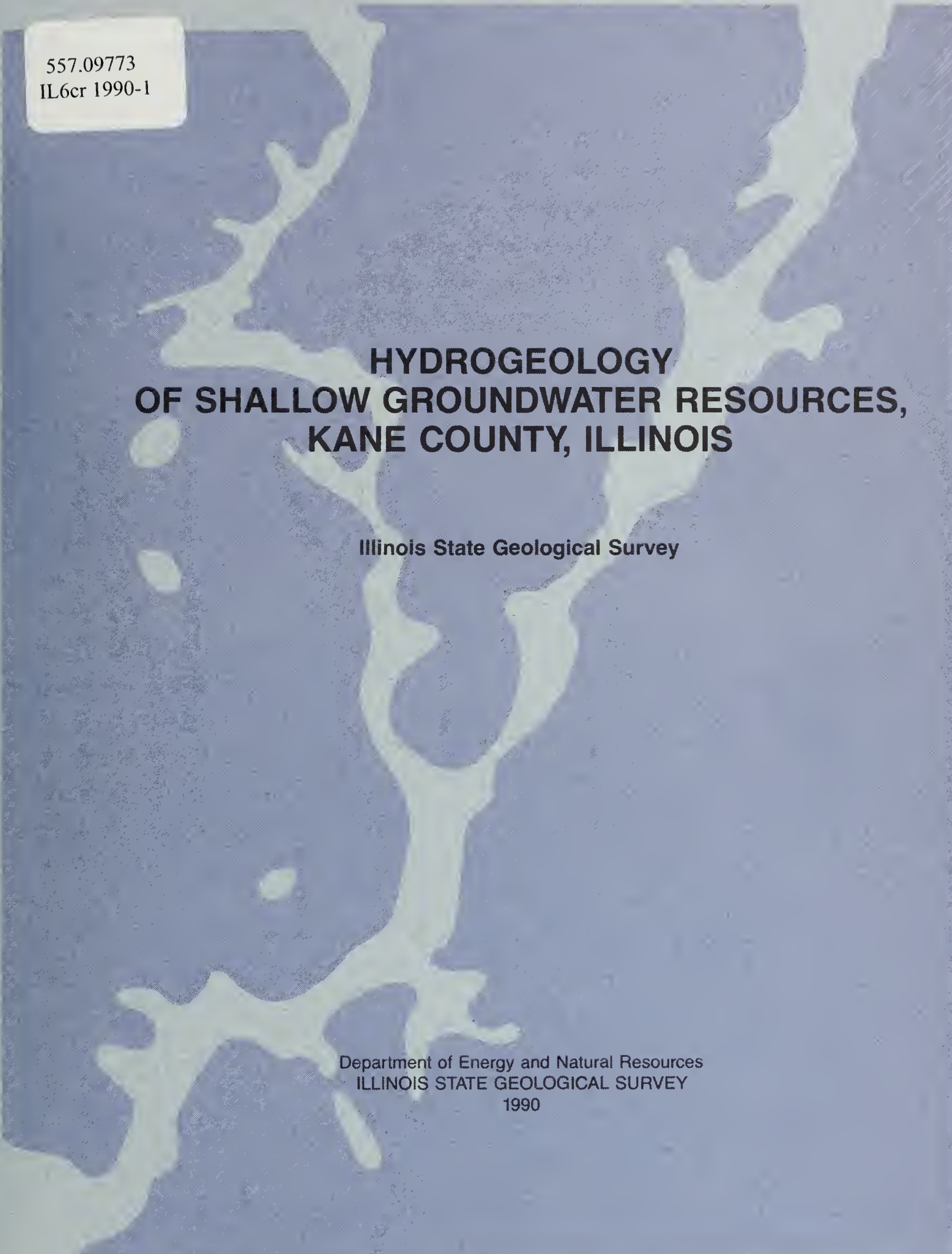

HYDROGEOLOGY OF SHALLOW GROUNDWATER RESOURCES, KANE COUNTY, ILLINOIS

Illinois State Geological Survey

Department of Energy and Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY
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1 Aquifers with potential for development of public water supplies: Prairie Aquigroup in Kane County, Illinois

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EXECUTIVE SUMMARY

OVERVIEW

Kane County and its many communities just west of Chicago have depended on public water supplied from sandstone bedrock aquifers 1,100 to 2,000 feet below ground surface. The demand for water from a growing population has resulted in overpumping, and thus lowered groundwater levels. Water levels have dropped more than 900 feet in the deep sandstone aquifers, known as the Midwest and Basal Bedrock Aquigroups, lying deep below the Fox River Valley (Sasman et al., 1982). Water quality is also a concern: concentrations of barium and radium in water pumped from these aquifers are higher than recommended by the U.S. Environmental Protection Agency (1975) (Gilkeson et al., 1983, 1984). Pumping from deep aquifers or transporting water from Lake Michigan is costly. Obtaining local groundwater sources from aquifer materials at shallower depths would be more cost effective if water quality and yield were satisfactory.

Several communities along the Fox River in Kane County and the Kane County Development Department contracted with the Illinois State Geological Survey and the Illinois State Water Survey in the mid-1980s to determine the potential for groundwater resources in (1) the Prairie Aquigroup, surficial materials or glacial drift deposited on bedrock during the Pleistocene Epoch from about 165,000 to about 10,000 years ago; and (2) the Upper Bedrock Aquigroup, fractured bedrock underlying the glacial drift. Drift consists of till (diamicton), sand and gravel, and stratified silt and clay more than 350 feet thick in places. Drift is thickest under the moraines left by glaciers and in "buried bedrock valleys" (fig. 1). These buried bedrock valleys became the focus of a search for shallow groundwater resources.

The Surveys divided the responsibility for this cooperative investigation, and the results are being published separately. The main goals of the Geological Survey's investigation were

- to locate and map the distribution and thickness of potentially water-bearing sand and gravel deposits, or aquifers, lying at relatively shallow depths in the glacial drift under Kane County. Both aquifers and nonaquifers of the Prairie Aquigroup and the Upper Bedrock Group have been described within a hydrostratigraphic framework that aids prediction and exploration. The fractured bedrock directly underlying the Prairie Aquigroup has been described briefly. The investigators proposed to demonstrate the effectiveness of surficial geophysical methods (seismic refraction and electrical earth resistivity) in prospecting for groundwater.

The main goals of the Water Survey's investigation were

- to evaluate the water chemistry, water-yielding properties, and long-term potential yields of sand and gravel deposits underlying Kane County, given the hydrostratigraphic framework developed by the Geological Survey.

METHODS

Geological mapping and surface geophysics were used to site test borings and production wells. Cross sections of the drift-filled buried bedrock valleys were constructed on the basis of well records, with both surface and borehole geophysics used for correlation. These cross sections aided in the design and interpretation of aquifer tests.

Buried bedrock valleys, which were expected to contain major groundwater resources, were the focus of the investigations:

1. Preliminary maps of the buried bedrock surface were plotted using outcrop elevations, existing records from water wells, and test borings with verified well locations.
2. Locations of buried bedrock valleys were refined using seismic refraction techniques.

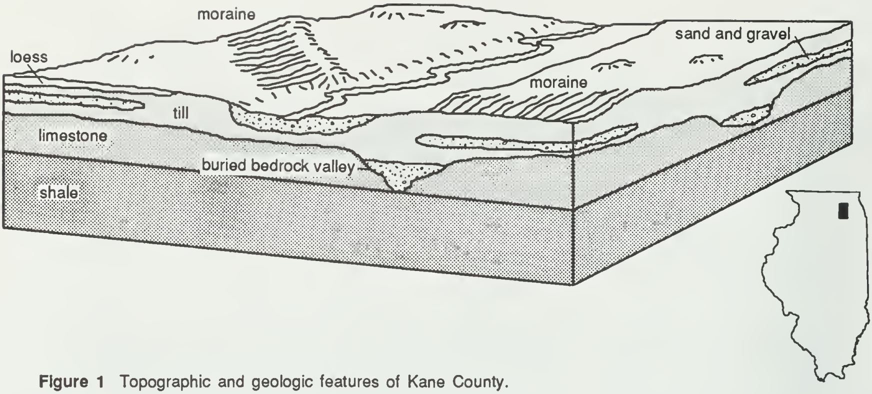


Figure 1 Topographic and geologic features of Kane County.

3. Prospecting for sand and gravel aquifers in bedrock valleys utilized electrical earth resistivity surveys.
4. Thickness and distribution of sand and gravel units (aquifers) within the bedrock valley fill were determined from test drilling and existing well data.
5. Data from piezometers and pump tests defined aquifer properties and boundaries. This was necessary for design and interpretation of the tests, which were complicated by the complex geology and geometry of the aquifers. Aquifer tests must be custom-designed to fit these factors if hydraulic characteristics are to be quantitatively assessed. Well location, design, and aquifer test duration must be adapted to site-specific criteria to test various models of aquifer properties.
6. Aquifer tests, conducted in three different buried bedrock-valley settings, provided data on water chemistry and well and aquifer yields.

Each of the steps outlined above is necessary to efficiently develop the shallow groundwater resource. The investigation of aquifer distribution concentrated on the sand and gravel deposits that are greater than 50 feet thick and fill buried valleys, which are generally less than 3,000 feet wide. The buried bedrock topography map of Kane County helps to define the location of valley deposits. The map is based on more verified datum points than is any other map of its kind in Illinois.

FINDINGS OF THE INVESTIGATION

Conditions are favorable for development of shallow groundwater resources for public water supplies. Tests show that aquifers in buried bedrock valleys underlying Kane County have specific capacities (pumping rate per foot of drawdown) that range from less than 10 gallons per minute per foot (gpm/ft) to more than 250 gpm/ft; these aquifers provide the necessary transmissivity (as much as 270,000 gpd/ft) for municipal well production, and an adequate volume of water for sustained long-term yields (Visocky, 1987a, 1987b). The areas with the best potential for groundwater development in the glacial drift are shown in figure 2 and plate 1.

Location of Water-Bearing Deposits

The Illinois State Geological Survey defined and described units within the Prairie Aquigroup, a hydrostratigraphic grouping. Focus was on the aquifers within the buried bedrock valleys,

Figure 2 Major aquifers of the Prairie Aquigroup in Kane County. Figures 5 and 12-14 show the three-dimensional relationships on cross sections A—A′, B—B′, C—C′, D—D′, E—E′, F—F′, and G—G′.

for example, the St. Charles aquifer (fig. 2, plate 1). This is because the deposits within and over these valleys are generally thick and include sediments that usually store and yield large amounts of water. As much as 120 feet thick, the St. Charles aquifer generally maintains a thickness of at least 50 feet spanning the bedrock valleys, which may be up to 3,000 feet wide. The continuity of water-bearing deposits may be interrupted by deposits that do not yield any significant amount of water.

The St. Charles aquifer was the main focus of this study. Geological mapping suggests that the distribution and thickness of other significant aquifers within the Prairie Aquigroup need further characterization.

"How much groundwater is available?" is a reasonable question frequently raised by local officials charged with the task of managing groundwater resources (Illinois Technical Advisory Committee on Water Resources, 1967). The resource lends itself to quantitative assessment (U.S. Water Resources Council, 1973). However, groundwater reservoirs are dynamic in nature; their withdrawal rates and patterns of extraction can be managed. Therefore, the development of the resource is subject to alternative plans, which may differ in their effects on yield potential, longevity of the supply, cost of recovery, impacts on other groundwater reservoirs or interconnection with surface water, and water quality.

The Illinois State Water Survey discusses aquifer yields and water quality in a separate publication. The appendix in this report contains a summary of the principal aquifer hydraulic properties from aquifer tests and specific capacity analyses, and a summary of the quality of water in Kane County wells. Data for the appendix were furnished by the Water Survey; interpretations of the data are presented in their report on the shallow groundwater resources of Kane County.

ACKNOWLEDGMENTS
We are grateful for the support of the Kane Country Development Department and the people representing municipalities in Kane County. Richard Young, Director of the Kane County Environmental Department, was particularly helpful in coordinating county and community interests. Partial funding was provided by the cities of Aurora, Batavia, Carpentersville, Elgin, Geneva, North Aurora, and St. Charles; and the villages of East Dundee, Elburn, Hampshire, Montgomery, South Elgin, Sugar Grove, and West Dundee.

Many of the Illinois State Geological Survey staff were involved with various stages of this project. Robert H. Gilkeson, currently with Roy F. Weston, Inc., Albuquerque, New Mexico, was the principal investigator for the Geological Survey during the early stages of the study. He was replaced as principal investigator by Stephen S. McFadden, now with Applied Engineering and Science in Atlanta, Georgia. Database creation, entry, and processing of well, seismic, and resistivity data were completed by Douglas Cantwell, Paul Heigold, Mary Holden, Douglas Laymon, George Lin, Joseph McGinnis, Robert McGuinness, Cynthia Morgan, Faith Stanke, and Cheryl Wegscheid. Geophysical field work and well location verification were performed by Douglas Cantwell, Craig Gendron, David Heidlauf, Paul Heigold, Douglas Laymon, Joseph McGinnis, Walter Morse, Phillip Orozco, Steven Padovani, Vickie Poole, John Skinner, Faith Stanke, Charles Tindell and Cheryl Wegscheid. Robert Vaiden compiled the bedrock topography map and assisted in the aquifer mapping. Richard Berg prepared the surficial drift map. Other professional expertise was provided by Ross Brower, Ardith Hensel, Phillip Reed, and Robert Vaiden. Keros Cartwright, Robert Gilkeson, Beverly Herzog, John Kempton, Stephen McFadden, and Nicholas Schneider reviewed the manuscript. The production editor was Ellen Wolf, text editor was Richard Davis, and graphic artists were Barbara Stiff and Pamella Foster.

HYDROGEOLOGY OF SHALLOW GROUNDWATER RESOURCES OF KANE COUNTY

INTRODUCTION

Public groundwater supplies in Kane County, Illinois, have been obtained principally from sandstone bedrock aquifers of Cambrian and Ordovician age. Overdevelopment of these deep sandstone aquifers has resulted in water-level drawdowns of more than 900 feet. Water quality is also a concern (Sasman et al., 1982) because these waters contain concentrations of naturally occurring radium and barium in excess of standards set by the U.S. Environmental Protection Agency (1975) (Gilkeson et al., 1983, 1984). In the mid-1980s, the Kane County Development Department and several Kane County communities contracted with the Illinois State Geological Survey and Illinois State Water Survey to assess the potential of other aquifers, including sand and gravel in the glacial drift (Prairie Aquigroup) and fractured bedrock below the glacial drift (Upper Bedrock Aquigroup). These two rock units, referred to as shallow groundwater aquifers, are underutilized and represent potential major sources of water for the county (Gilkeson et al., 1987).

Framework

Evaluating the groundwater resources of the Upper Bedrock and Prairie Aquigroups begins with the description of the age, sequence, and composition of the geologic materials in addition to their capacity to store and transmit groundwater. The descriptions constitute a stratigraphic framework used to predict, among other things, the characteristics and distribution of rocks between datum points. This is accomplished by first describing independent stratigraphic categories of units: (1) lithostratigraphy, which delineates and distinguishes rocks on the basis of composition (lithic characteristics) and sequence (stratigraphic position) and composition; (2) chronostratigraphy, which defines the age of the rocks of this composition (lithology); and (3) hydrostratigraphy, which describes the hydrogeology within the rocks. These categories depend on descriptions at a reference section, a locality chosen for study. Away from the reference section, identical or similar material properties are matched and correlated. The results are depicted on geologic maps. For the most part, chronostratigraphic and lithostratigraphic units correspond. Until recently, these have been the primary mapping units in the bedrock and glacial drift in Illinois (Lineback, 1979).

Hydrogeology involves the occurrence, direction of flow, and storage of groundwater below the surface of the earth. In this report, the hydrogeology of the rock units is described in terms of hydrostratigraphy, which is similar to lithostratigraphy in that the composition and sequence of the rock units are described. In addition, hydrostratigraphy describes the porosity of the rock and its ability to transmit water (permeability). Hydrostratigraphic units are primarily distinguished and characterized on the basis of porosity and permeability. Hydrostratigraphy involves the study and mapping of not only the solid rock material but also the character and nature of the pores and fractures (interstices) in the rock (Seaber, 1988).

For this investigation, a hydrostratigraphic framework was developed describing the occurrence, location, extent, and thickness of the water-yielding and non-water-yielding deposits of glacial drift and the bedrock immediately underlying the drift. This framework will be used by the Illinois State Water Survey in their discussion of the water quality and yields of the aquifers underlying Kane County.

Hydrogeologic Setting

The shallow bedrock in Kane County consists of the Kankakee and Elwood Formations, Silurian in age and composed mostly of dolomite, and the Maquoketa Group, Ordovician in age and composed of shale and argillaceous dolomite (Graese et al., 1988). The bedrock has been referred to as the "shallow dolomite aquifer" (Schicht et al., 1976; Sasman et al., 1982) and is known formally as the Upper Bedrock Aquigroup (Visocky, Sherrill, and Cartwright, 1985).

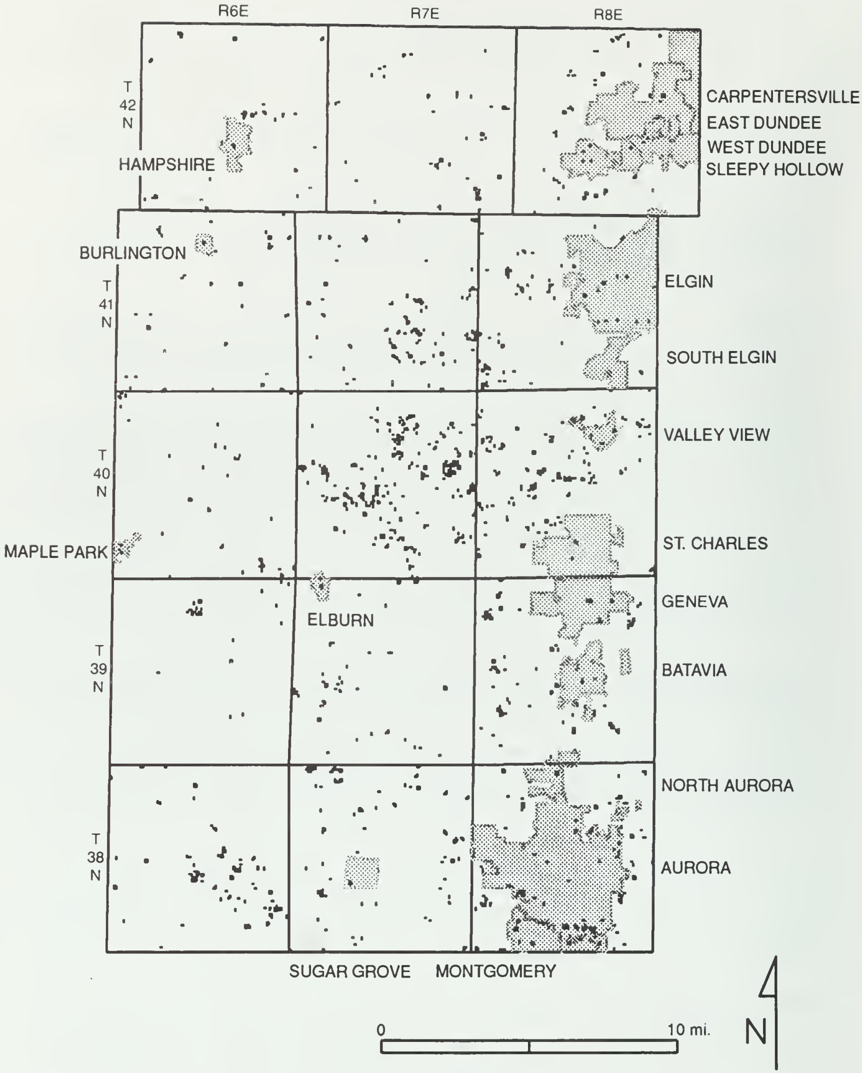


Figure 3 Generalized distribution and well locations in relation to Kane County communities (screened areas). Dots indicate verified well locations.

The bedrock surface, buried by Pleistocene glacial deposits, resembles modern topography featuring hills and valleys. Buried bedrock valleys generally contain the thickest deposits and the greatest volume of sands and gravels of glacial-fluvial origin. Geological reasoning points to the bedrock valley systems as having the greatest potential for containing predictable and high-yielding aquifers. Bedrock valley aquifers can be recharged not only from overlying drift, but by groundwater stored in fractures in weathered bedrock in the valley walls and immediately below the glacial drift. Valley-fill deposits not only consist of fluvial sands and gravels that are excellent aquifer materials, but also contain fine-grained diamicton (glacial till or debris flows) and lacustrine (lake bed) deposits that are poor aquifer materials, or aquitards. The ability to predict the location of aquifers and the water yield from these aquifers will improve as the bedrock-valley sediments continue to be explored and sedimentological models are developed to explain the genesis of the deposits.

The Prairie Aquigroup (glacial or surficial deposits above the bedrock) has been informally divided into aquiformations, such as aquifers (water-yielding deposits) and aquitards (non-water-yielding deposits). Maps and cross sections show the distribution and thickness of aquiformations in the glacial drift in Kane County. How they were constructed and how they should be used to prospect for groundwater resources will be discussed under methods of investigation. The maps and cross sections depict the distribution and thickness of the various hydrostratigraphic units, including the St. Charles, Valparaiso, Bloomington, and Kaneville aquifers; the Pingree Grove and Elburn aquiformations; and the Marengo aquitard. An important hydrostratigraphic unit in the Prairie Aquigroup is the St. Charles aquifer consisting of sand and gravel that fills several buried bedrock valleys. This aquifer was the focus of testing by the Illinois State Geological and Water Surveys.

The maps in this report are regional in scope, intended only for countywide planning. Areas have been mapped and units correlated by interpreting geologic information from drillers' logs or core samples. As in any geologic mapping, interpretations have been made between datum points, and the resulting maps and cross sections are considered to be the best present interpretations of the available data. This information is a reference for exploring, developing, and managing the groundwater resources of Kane County.

METHODS OF THE HYDROGEOLOGICAL INVESTIGATION

Geological mapping and surface geophysics were used to guide location and siting of test borings and production wells. Cross sections of the drift-filled buried bedrock valleys, prepared using well records and surface and borehole geophysics for correlation, aided in the design and interpretation of aquifer tests. Buried bedrock valleys, which were expected to contain major groundwater resources, were the focus of the investigations:

1. Preliminary maps of the buried bedrock surface were plotted using elevations of outcrops and records from water wells and test borings with verified locations as datum points (fig. 3).
2. Locations of buried bedrock valleys between datum points were interpreted using seismic refraction techniques (fig. 4).
3. Prospecting for sand and gravel deposits in bedrock valleys utilized electrical earth resistivity surveys.
4. Thickness and extent of sand and gravel bodies within the bedrock valley fill were determined by test drilling.

In addition to existing sources of data, several new sources were used to construct maps and cross sections. These include seismic refraction studies conducted for the communities

Figure 4 Location of seismic refraction survey lines, which indicate extent of coverage. A—A' is shown on figure 5.

of Montgomery (McFadden, Gendron, and Stanke, 1989), Aurora, and Geneva (Gilkeson et al., 1987), as well as seismic studies related to the proposed site for the Superconducting Super Collider in Illinois (Heigold, personal communication). For this study, test holes at six sites focused on characterizing geologic materials in the buried bedrock valleys. Sixteen test holes drilled for the SSC siting effort in Kane County yielded information on drift and bedrock lithology. Pressurized packer tests, performed in bedrock at most of these holes, provided local information on the hydraulic conductivity of the rock units (Kempton et al., 1987a, 1987b; Curry et al., 1988). Information from published reports was also used in constructing the maps and cross sections (Lund, 1965; Reed, 1975; Woller and Sanderson, 1978; Kempton, Bogner, and Cartwright, 1977). The bedrock topography map prepared by Robert Vaiden for this report is based on the same data; it is nearly identical to that presented in Graese et al. (1988).

Water Well Records

A rigorous effort, part of a program started in 1976, was made to establish accurate locations for wells distributed across the county. Special attention was given to wells overlying buried bedrock valleys. Maps and files in the Kane County Building Permits Office aided in the rapid determination of locations for most records; landowners were queried when necessary. More than 1,800 well locations were verified (fig. 3).

The description of lithology from water well records is often unreliable and misleading, but the elevation of the drift/bedrock contact is usually easily distinguishable. Records of municipal supply wells in addition to test drilling by the State Surveys have provided detailed and accurate data of the lithologic units. Published sources of well and test-hole records in Kane County include Lund (1965), Landon and Kempton (1971), Reed (1975), Woller and Sanderson (1978), Kempton et al. (1985, 1987a, 1987b), Curry et al. (1988), Vaiden et al. (1988), Eidel, Zelinsky, and Visocky (1989), and McFadden, Gendron, and Stanke (1989). The records contain information on bedrock depth below land surface, as well as drift and bedrock lithology and thickness.

Surficial Geophysical Methods

Assessment of the well database suggested that Kane County contained significant shallow groundwater resources. The database was not adequate, however, for accurately locating or evaluating these resources. A mapping program based on the extensive use of two surface geophysical methods, seismic refraction and electrical earth resistivity, helped to delineate the distribution of the sand and gravel deposits in the Prairie Aquigroup of Kane County.

Seismic Refraction This method was used to aid mapping the buried bedrock surface and the drift thickness. More than 150 miles of seismic refraction profiles in Kane County were analyzed using approximately 1,140 seismic refraction survey lines (fig. 4). A high degree of confidence in the accuracy of glacial drift thickness and bedrock topography was possible because of the large and significant contrast between the seismic velocities of glacial materials and bedrock in Kane County.

Reversed profile seismic data were collected using a 24-channel signal-enhancement seismograph. This instrument uses a buried explosive charge or weight-drop system as an energy source to produce seismic waves, which are recorded and interpreted. Field data were automatically processed with a modified version of a ray-tracing program called SIPT-1 (Scott et al., 1972). An interactive data-entry program was used to enter field data into the SIPT-1 program (Laymon, 1986), which corrects for irregular surface terrain along the seismic profile and also calculates depth to bedrock beneath each geophone. Geophones were spaced 50 or 100 feet apart along lines 650 or 1,300 feet in length, respectively, depending on the estimated thickness of the glacial drift and velocities of the materials.

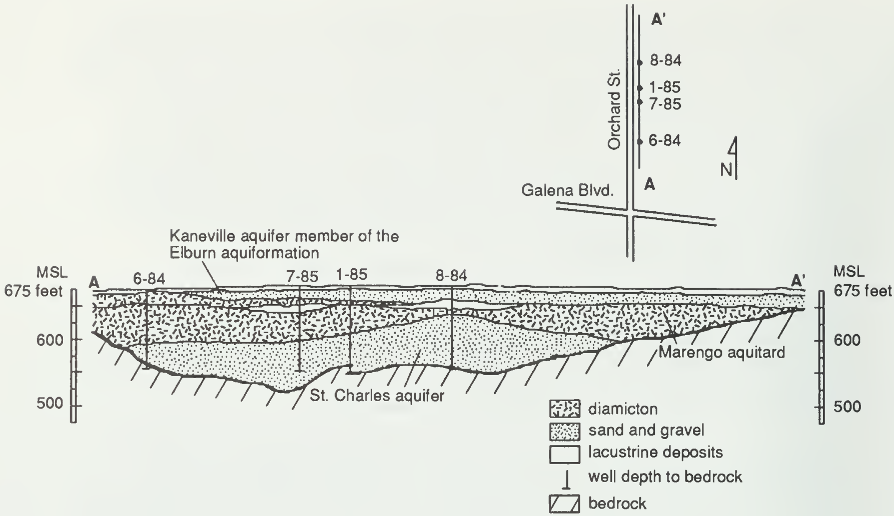


Figure 5 Profile of bedrock topography as interpreted by seismic refraction methods and demonstrated agreement from drilled wells. Section line A-A' is located on figures 2 and 4 and plate 1.

The seismic refraction method accurately determined the depth of the bedrock surface except in areas where thick sand and gravel deposits are overlain by thick, dense, clay-rich glacial till (Zohdy et al., 1974). Where a thick basal sand and gravel layer is underlain by bedrock and confined above by a higher velocity clay-rich till, the solution of the reversed seismic profiles over the valley indicated an anomalously great depth to bedrock. Because deposits of buried sand and gravel are often prolific aquifers, the anomalous depths are potential targets for further evaluation of groundwater resources (Laymon and Gilkeson, 1989).

Figure 5 shows an example of the accuracy of the seismic refraction method. The thick line is the bedrock topography interpolated between data points generated by the SIPT-1 program. The actual depth to bedrock, as indicated by subsequent test drilling, shows that the maximum error is about 25 feet where the drift is about 125 feet thick.

Electrical Earth Resistivity In the regional exploration program, electrical earth resistivity (EER) was used to identify sand and gravel deposits in the glacial drift, particularly in buried bedrock valleys. This method is based on the electrical properties of geological materials. Sand and gravel saturated with fresh water has much greater resistance to the passage of an electrical current than finer grained sediments such as silt or till. Identification of sand and gravel by EER methods is difficult where deposits are thin and deeply buried. Applying EER methods in Kane County was difficult because dolomite and shale bedrock also have high resistivities. Accurate interpretation of the vertical electrical soundings thus requires knowledge of the depth to bedrock. Approximately 500 EER stations were sited in Kane County. A Schlumberger electrode configuration was used (Zohdy et al., 1974) and the data were inverted by layering parameters (Zohdy, 1973).

Test Drilling
The geophysical surveys were followed by drilling test holes in areas that appeared favorable for locating new large, productive sources of water. Local communities cooperated in developing well fields in aquifers that were identified in the regional mapping program. Geophysics was used to guide the location of exploratory holes that were then finished as monitoring wells.

Test drilling identified potential aquifer materials, contributed to lithostratigraphic correlation, and provided information for the design of an aquifer test and production well. Test holes were drilled by rotary equipment. Washed cuttings and split-spoon samples were collected at selected intervals and logged. The particle-size distribution of the sand and gravel deposits was determined by dry sieving and used to aid in designing the wells.

Generally, test drilling extended 10 feet into the bedrock to determine shallow bedrock lithology and to confirm the location of the drift-bedrock contact. The wells were completed using 3-inch-diameter PVC casing and screened opposite the aquifer intervals for use as observation wells during aquifer testing. The lithologic and geophysical logs for the test holes are on open file at the Illinois State Geological Survey and available for inspection.

Test holes were geophysically logged using a natural gamma-ray probe. Natural gamma-ray logs measure low levels of radiation primarily from the naturally occurring radioisotopes of uranium, potassium, and thorium. These elements are usually most abundant in clay-rich till and shale, and less abundant in clay-poor sand and gravel deposits and carbonate rocks (Kempton et al., 1987a). The data from lithologic and natural gamma-ray logs were extrapolated to map the thickness and areal extent of shallow aquifers.

The surface geophysical and borehole data were integrated to map the nature and boundaries of the sand and gravel aquifers and to design aquifer tests. This method provides sufficient information to determine the best location to drill a production well and should result in considerable savings in the cost of developing a municipal well field.

Production wells were drilled where favorable results were obtained from test drilling. In such cases, aquifer tests were conducted by the Illinois State Water Survey to determine aquifer hydraulic properties; the results are discussed in the Water Survey's report on the shallow groundwater resources of Kane County. This type of information is used to determine the sustained yield of the well, and the potential yield of the well or potential well fields with a specific spacing of several wells. Water samples for chemical analyses were collected during aquifer tests.

GEOLOGY
The geology of Kane County has three major components: Precambrian crystalline basement rocks, Paleozoic sedimentary bedrock, and Cenozoic glacial drift (fig. 6). The top of the Precambrian rocks occurs from 2,400 to 3,550 feet below mean sea level (msl) in Kane County (Sargent and Buschbach, 1985). The Paleozoic sedimentary rocks, which were deposited from about 600 to 245 million years ago, are as much as 4,000 feet thick (Graese et al., 1988). The Cenozoic deposits classified in the Quaternary System and Pleistocene and Holocene Series are probably no more than about 200,000 years old, and many deposits are about 25,000 to 14,000 years old (Johnson, 1986). The glacial drift is more than 350 feet thick (Wickham, Johnson, and Glass, 1988; Graese et al., 1988).

A discussion of the upper Paleozoic and Cenozoic rocks significant for this report follows.

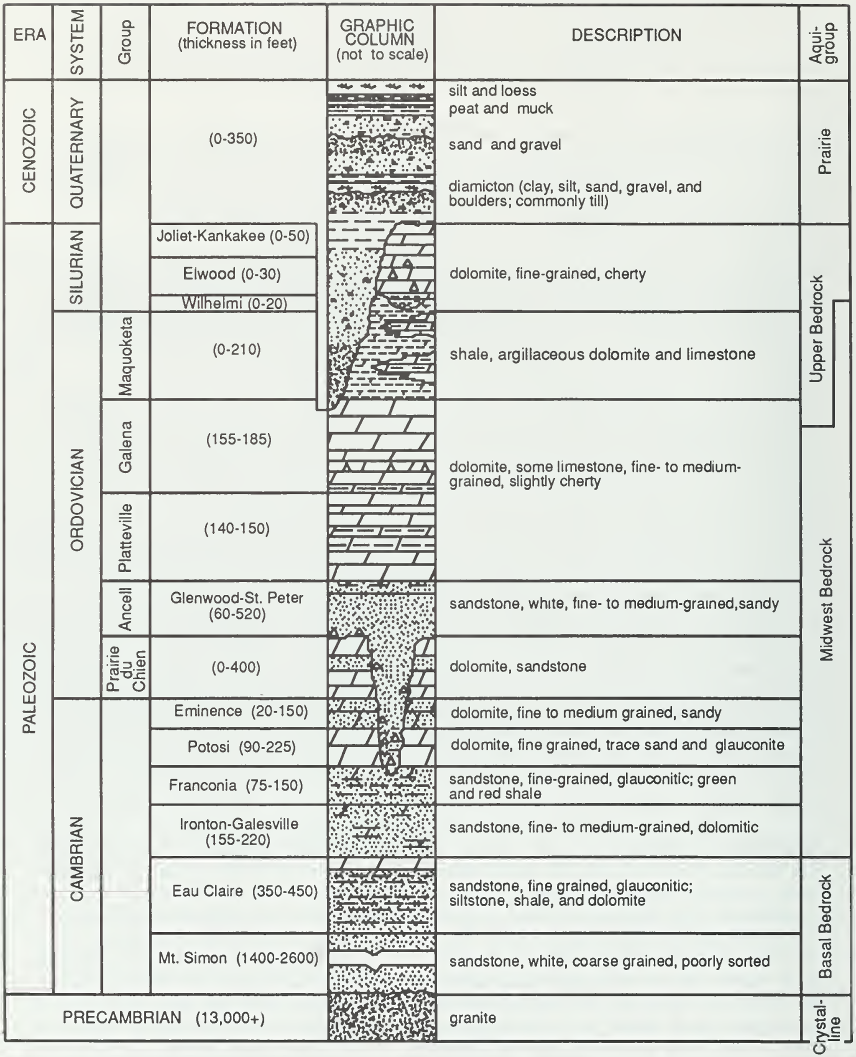


Figure 6 Stratigraphy of rocks underlying Kane County.

Stratigraphy

Paleozoic

The Galena, Maquoketa, Kankakee, and Elwood Formations are the most widespread units beneath the bedrock surface (fig. 7). Distribution of the geologic units is determined by the structure of the bedrock, thickness of the units, and most importantly on a local scale, the topography of the bedrock surface.

Ordovician • ***Galena Group*** Composed of nearly pure medium- to fine-grained carbonates, both dolomite and limestone, the Galena also contains chert nodules and shaly zones, but these are not as common as in the underlying Platteville. The average thickness of the Galena is about 180 feet beneath Kane County (Graese et al., 1988). The Galena is present at the buried bedrock surface only where the dominant St. Charles bedrock valley exits Kane County on the southwest.

• ***Maquoketa Group*** Composed of shale, argillaceous dolomite and limestone, and interbeds of shale and dolomite, the Maquoketa is as much as 210 feet thick in the northwest where it is overlain by the Kankakee Formation. The Maquoketa is not present, however, in the southwestern portion of Kane County in the bottom of the St. Charles bedrock valley. The regionally important formations of the Maquoketa include, in ascending order, the Scales Shale, Ft. Atkinson Limestone, Brainard Formation, and Neda Formation (Kolata and Graese, 1983); but these cannot be readily differentiated in Kane County (Graese, 1988; Graese et al., 1988). Instead, the Maquoketa consists of two sequences composed of basal shales that become increasingly carbonate rich. Figure 7 shows the distribution of lithologies dominated either by shale or dolomite.

Silurian The Elwood and Kankakee Formations are composed of thin to medium-thick beds of dolomite; the Kankakee also contains abundant nodules and interbeds of chert. Because the lithology of these units is similar, they are not differentiated on figure 7. The thickness of the two units is more than 100 feet on the southeast of Kane County, where the Joliet Formation may be present as well. The Joliet is also composed of dolomite; and in the subsurface, it is difficult to distinguish from the underlying Kankakee. The Wilhelmi Formation may be present in places where the top of the Maquoketa is deeply eroded (Graese et al., 1988, p. 17); it is composed of argillaceous dolomite and domomitic shale (Willman et al., 1975, p. 26). The distribution of Silurian dolomite, as depicted in figure 7, is determined chiefly by the buried bedrock topography. The Silurian subcrop corresponds, in large part, to the bedrock valleys (fig. 10). The thickness of Silurian dolomite beneath the outliers in R.6.E. of Kane County is generally less than about 30 feet.

Cenozoic

Quaternary: Pleistocene The lithology of the Pleistocene glacial drift (fig. 8) has more diversity than that of the bedrock units (fig. 6). The distribution of the surficial drift units is shown on figure 8b. The bulk of the drift is composed of matrix-supported loam to clay diamicton (till), well-sorted to poorly sorted sand and gravel (outwash), subordinate stratified silt and clay (lacustrine deposits), and organic-rich, pedogenically altered sediment (buried soils). Many differences in the lithology of the glacial sediments can be explained in terms of the sedimentology (Eyles, 1983; Ashley, Shaw, and Smith, 1985).

Predicting the occurrence of aquifers depends upon understanding the sedimentology of the glacial drift, which is important for understanding the resulting hydrostratigraphy because of the numerous unconformities and abrupt facies changes in drift sequences (Anderson, 1989). A glacial setting is dynamic, especially along the front of the ice sheet. The glacial front advances and retreats, and through time, covers or removes earlier deposits. The results are

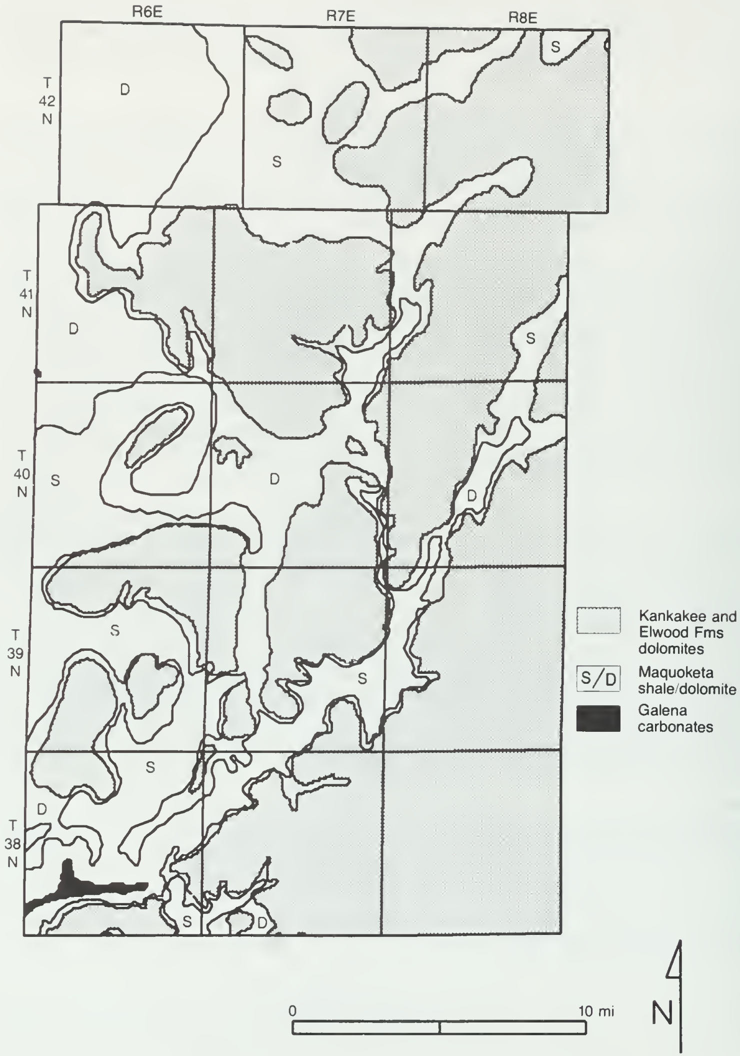


Figure 7 Paleozoic rock units outcropping at the buried bedrock surface (modified from Graese et al., 1988).

the facies changes previously mentioned (fig. 9). Sand and gravel deposits fill much of the buried bedrock valleys and occur as sheet deposits elsewhere in the county. In the St. Charles bedrock valley, these deposits are late Wisconsinan (about 25,000 years old), but in the Aurora bedrock valley, the deposits are Illinoian (more than 130,000 years old). Figure 9 shows several environments of glacial deposition. The stratigraphic framework (fig. 8) is helpful for understanding the sequence of events, and in some cases, for determining the continuity of sand and gravel bodies.

The general history of continental glaciation in Kane County includes two major periods of glaciation, the Illinoian and late Wisconsinan, that were separated by a long, warmer, soil-forming interval (interglacial) during the Sangamonian and early to middle Wisconsinan (Curry, 1989). Pre-Illinoian glaciations probably affected Kane County, but deposits of this age have not been identified. The position of fluctuating glacial margins during the late Wisconsinan are marked by various landforms, including end moraines and outwash fans, but older deposits now covered have no surface expression.

• ***Illinoian*** The oldest glacial drift identified in Kane County is Illinoian and may correlate to the Glasford Formation near Rockford in Boone and Winnebago Counties (Berg et al., 1985). Richmond and Fullerton (1986) suggest that the Illinoian spans from about 245,000 to 130,000 years ago.

• ***Sangamonian and Early to Middle Wisconsinan*** Illinoian deposits are covered by Sangamonian and early to middle Wisconsinan colluvium composed of organic carbon-rich silty deposits that have been modified by soil formation; these include Berry Clay and Robein Silt (fig. 8). The soils were developed from about 130,000 to about 25,000 years ago (Curry, 1989). These sediments may be as much as 25 feet thick in Kane County, but are more commonly thin or absent.

• ***Late Wisconsinan*** The late Wisconsinan Wedron Formation, Henry Formation, and related formations (Willman and Frye, 1970) cover the Robein Silt.

Wedron Formation The bulk of the late Wisconsinan deposits belong to the Wedron Formation; its representative members in Kane County in ascending order are the Tiskilwa, Malden, Yorkville, and Haegar Till Members (fig. 8). The till members can be separated on the basis of particle-size distribution, semiquantitative mineralogy of the less than 2-micron fraction, color, and stratigraphic position. Wickham, Johnson, and Glass (1988) and Graese et al. (1988) summarize these properties.

Henry Formation The Henry Formation consists of sand and gravel; its distribution and thickness are relatively well known because of its importance as an aggregate resource (Masters, 1978). The Henry is subdivided into three members based on association with landforms (Willman and Frye, 1970), including the Mackinaw Member (valley trains), Wasco Member (kames and eskers), and the Batavia Member (fans and deltas).

Equality Formation The Equality Formation is composed of stratified to massive sand, silt, and clay associated with sedimentation in lakes. The Dolton Member is composed of well-sorted fine- to medium-grained sand deposited along shorelines and spits; it is only locally present in large lake deposits in northern Kane County (Leighton et al., 1931; Wickham, Johnson, and Glass, 1988). The Carmi Member is composed of chiefly stratified or laminated silt, clay, and subordinate sand; it is a common surficial deposit across Kane County (Graese et al., 1988). Generally, it is less than 20 feet thick, but may be as much as 45 feet thick.

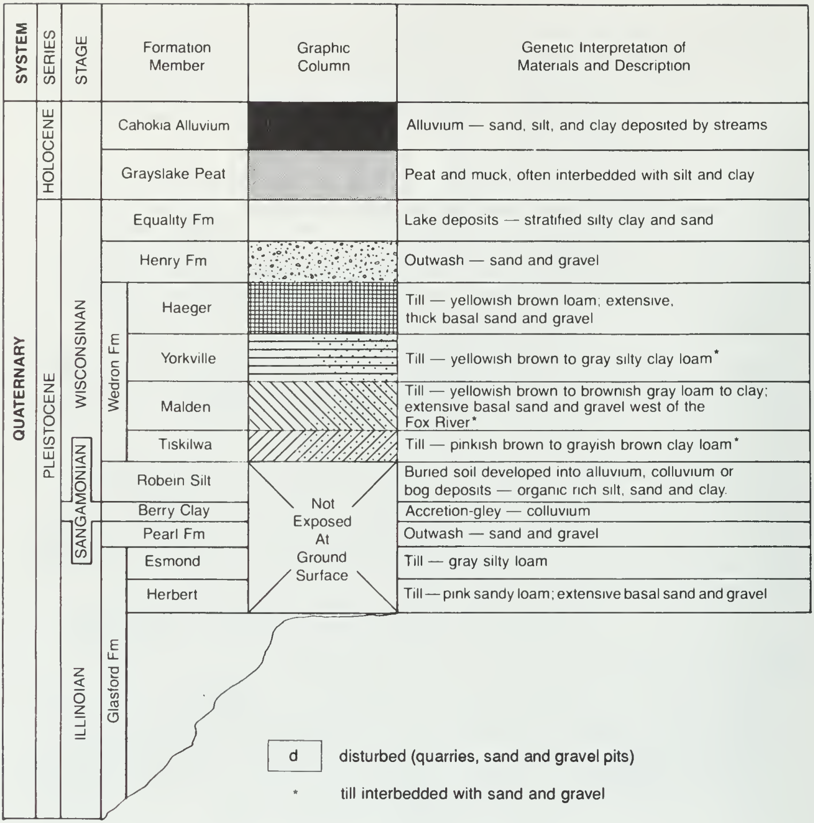
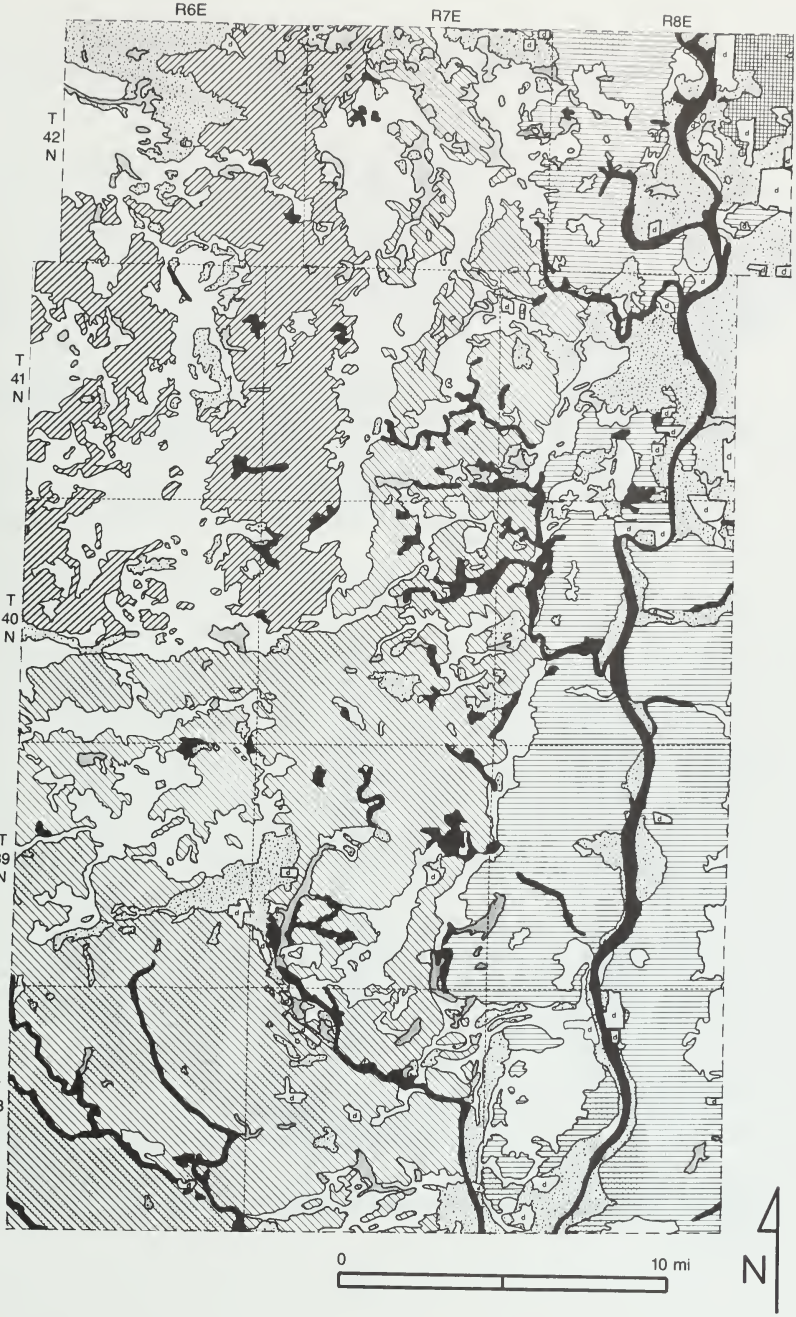


Figure 8a Stratigraphy of glacial drift (Prairie Aquigroup) underlying Kane County.

Figure 8b Surficial drift map of Kane County (modified from Graese et al., 1988).



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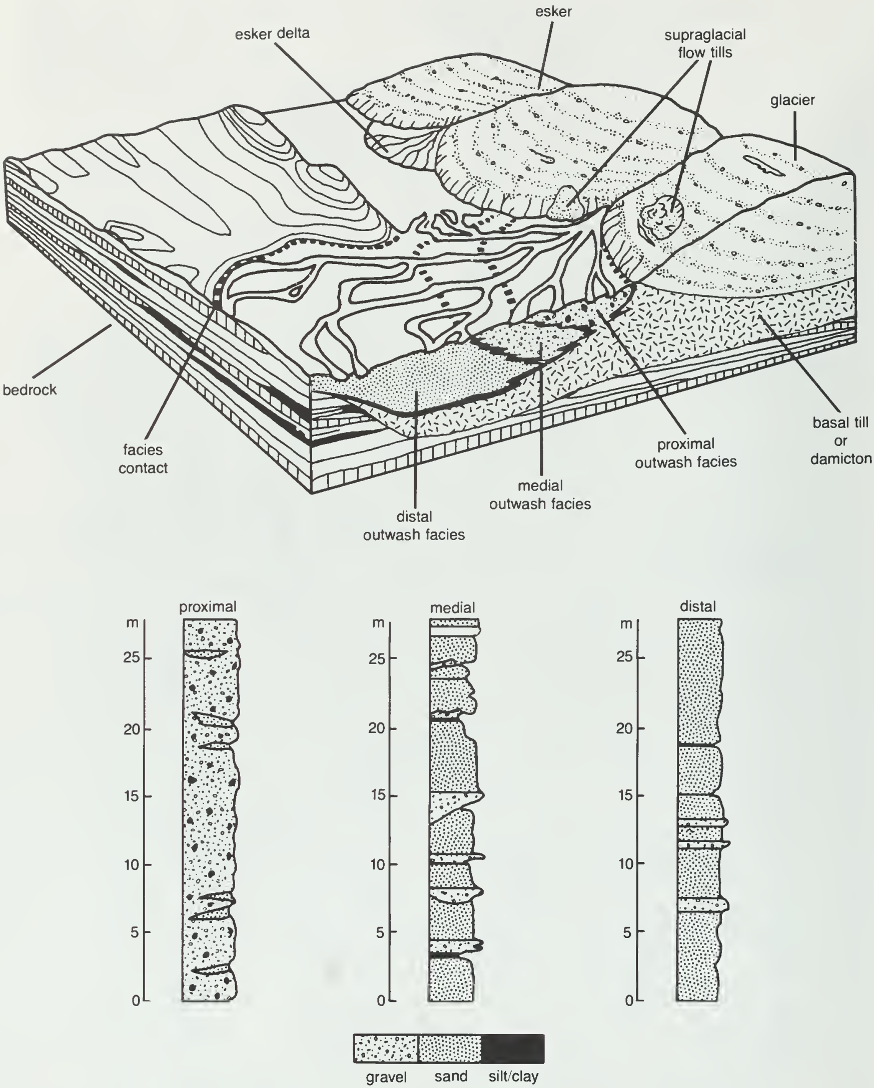

Figure 9 Environments of glacial deposition (from Anderson, 1989). Dotted lines indicate facies contacts.

• ***Post-late Wisconsinan and Holocene deposits*** Post-late Wisconsinan glacial deposits are thin and mantle the ground surface. Cahokia Alluvium (floodplain deposits) and Grayslake Peat are mapped on figure 8b. Richland Loess and Peoria Loess are generally less than 2 feet thick and have not been included on the maps for this report.

Buried Bedrock Topography

The bedrock surface has been mapped statewide by Horberg (1950) and in Kane County by Gilkeson and Westerman (1976), Wickham (1979), Wickham and Johnson (1981), and Wickham, Johnson, and Glass (1988). The bedrock topography map has been updated as a result of seismic refraction studies (Heigold, personal communication) and the test drilling for the proposed site for the Superconducting Super Collider in Illinois (Kempton et al., 1987a, 1987b; Curry et al., 1988; Vaiden et al., 1988). Additional data came from logs on open file at the Illinois State Geological and Water Surveys. The map in this report (fig. 10) is similar to the bedrock topography map in Graese et al. (1988).

The elevation of the bedrock surface is less than 500 feet above mean sea level (msl) at the bottom of the St. Charles bedrock valley on the southwest of Kane County, and more than 825 feet above msl on the uplands to the northwest (fig. 10). The surface is dissected by several troughs that resemble modern valleys; the genesis of the bedrock valleys was probably similar to that of a modern valley system, but the possibility remains that some reaches were modified by glacial erosion during the Quaternary Period. The age of the valley fill varies, indicating that the history of the drainage network is complex.

Buried Bedrock Valleys

The individual buried bedrock valleys described below are indicated (by a stippled pattern) on the bedrock topography map (fig. 10).

St. Charles bedrock valley The major bedrock valley under Kane County, the St. Charles bedrock valley, heads east near Elgin and parallels the Fox River on the north, diverging from and crossing beneath the Fox River just south of St. Charles. The St. Charles bedrock valley lies just west of Batavia and Geneva and trends southwest to pass beneath State Route 47 north of Sugar Grove and eventually exits Kane County on the extreme southwest. The St. Charles bedrock valley was once thought to extend south from Aurora to near the village of Newark in Kendall County, but new data suggest a westward route west of Kane County and eventual confluence with the Paw Paw bedrock valley in Lee County. The Paw Paw is a tributary to the ancient, buried channel of the Mississippi River (Horberg, 1950). Therefore, the bedrock valley formerly called "Newark" has been renamed the St. Charles bedrock valley.

Aurora bedrock valley A major tributary of the St. Charles bedrock valley, the Aurora bedrock valley is a narrow, sinuous feature trending approximately east-west across the southern part of Kane County. The valley begins in western Du Page County east of Montgomery and passes beneath the Fox River in southern Aurora, trending west where it joins the St. Charles in southeastern Kane County (Graese et al., 1988).

Other buried bedrock valleys Other tributaries to the St. Charles bedrock valley occur in Kane County. Prime targets for aquifer development include the Elgin bedrock valley that heads northwest of Elgin and joins the St. Charles bedrock valley west of St. Charles. Another prominent tributary is the Elburn bedrock valley that merges with the St. Charles about 2 miles south of Elburn. Other smaller, unnamed valleys are evident in figure 10 (although they are not marked by a pattern), including a valley that apparently trends toward Lake Michigan and may have joined ancient drainage to Hudson Bay or the St. Lawrence

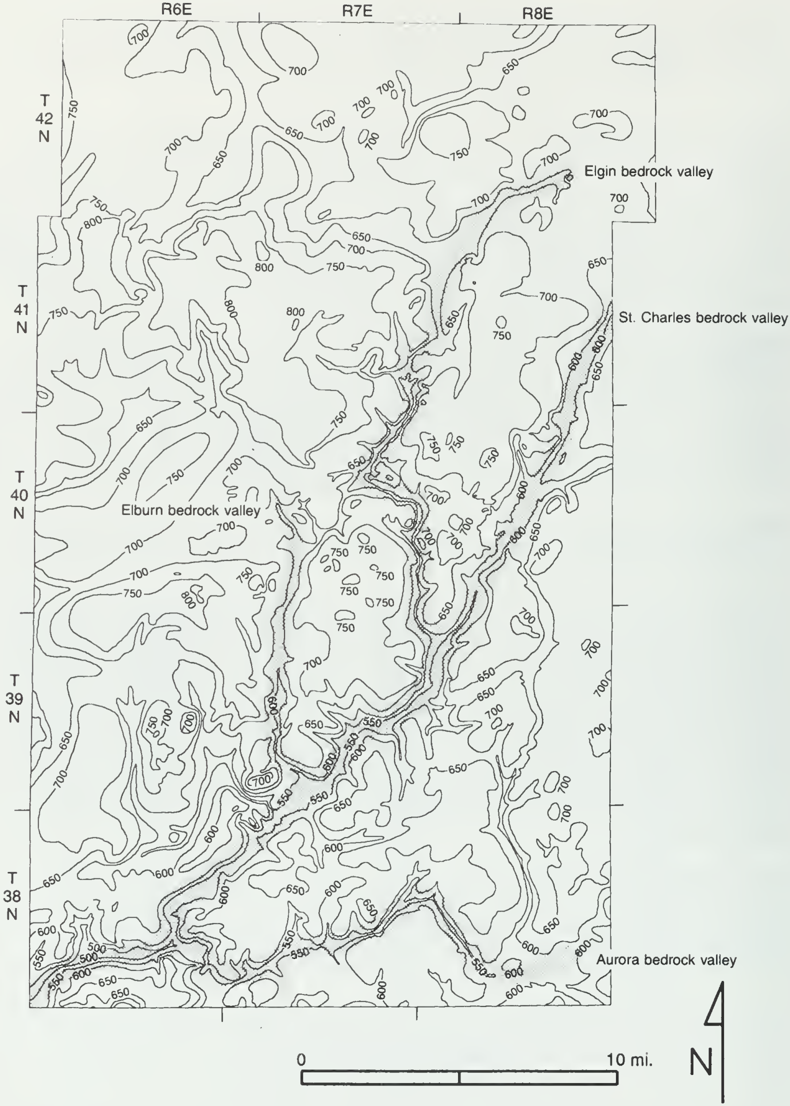

Figure 10 Buried bedrock topography underlying Kane County. A stippled pattern indicates the major bedrock valleys.

River. Small valleys on the west of Kane County, including one near Maple Park, join the Troy bedrock valley in De Kalb County. These relations imply that the central part of Kane County was part of a preglacial drainage divide.

Cross-valley topographic profiles of modern ground surface and the bedrock surface across the St. Charles and Aurora bedrock valleys and the modern Fox River Valley show similar relief of about 150 feet. The buried valley width varies from less than 2,000 feet to more than 3,000 feet. The steepest documented valley slope is about 13°, and the gradient of the St. Charles valley channel bottom is about 0.0006 feet per mile.

Drift Thickness

Glacial drift is more than 350 feet thick beneath the Marengo moraine and more than 200 feet thick above reaches of the St. Charles bedrock valley. Bedrock is locally exposed along the Fox River and a few tributaries. Drift is thickest beneath moraines and other positive glacial landforms such as kames, or above bedrock valleys, especially on the northern half of Kane County. Drift is thinnest in the southern part of Kane County along major drainageways and above outliers of Silurian dolomite. A drift thickness map (the result of subtracting the elevation of the bedrock surface from U.S. Geological Survey 7.5-minute topographic maps) will soon be available for Kane County (ISGS, 1990). It can be used with aquifer maps to give a crude indication of the level of natural protection afforded the aquifers described in this report.

HYDROGEOLOGY

Definitions of Aquifers

The term aquifer has been used in Illinois in different ways (Seaber, 1989). Aquifers in geologic mapping have been defined as (1) relating groundwater to the classical geological (lithostratigraphic) framework without detailed regard for hydraulic continuity, (2) relating groundwater occurrence to the hydraulic properties within the classical geologic framework, (3) showing groundwater as a resource, (4) showing the relationship of groundwater to water-bearing characteristics of the rocks and the dynamics of the hydrogeological regime, and (5) hydrostratigraphic units.

Usage and mapping has been strongly influenced by existing conventions. The term aquifer has been used in many different senses in the past in Kane County, but only hydrostratigraphic nomenclature is used in this report. A comparison of the hydrostratigraphic names used in this report and previous, informal usage is given in table 1.

Table 1 Informal classifications of drift aquifers compared with hydrostratigraphic units in the Prairie Aquigroup, as used in this report

McFadden et al. (1989)	*Schicht et al. (1976)*	*Graese et al. (1988)*	*This report (Prairie Aquigroup)*
Upper sand and gravel aquifer	Surficial sand and gravel aquifer	Surficial drift aquifer	Valparaiso aquifer Kaneville aquifer, Elburn aquiformation
	Interbedded sand and gravel aquifer	Basal drift aquifer	Bloomington aquifer Pingree Grove aquiformation
Lower sand and gravel aquifer	Basal sand and gravel aquifer	Buried drift aquifer	St. Charles aquifer

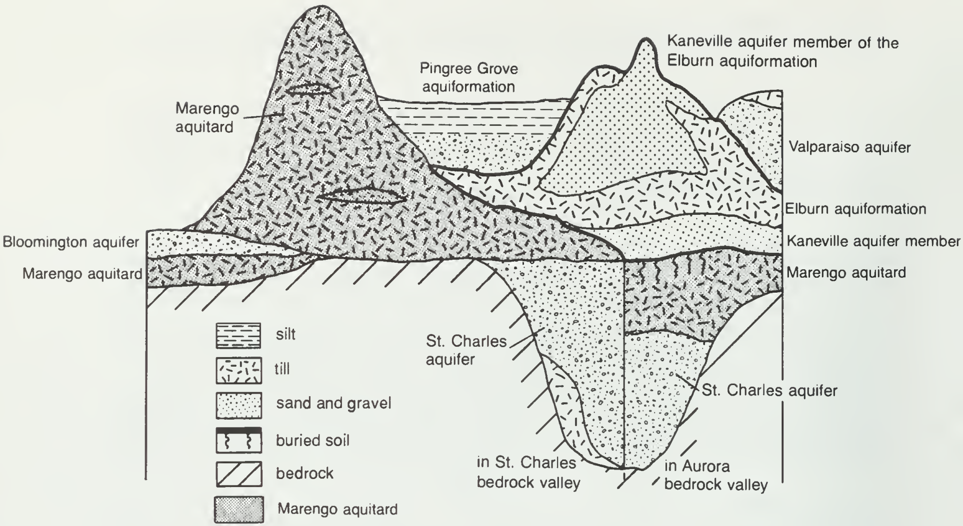

Figure 11a Schematic diagram showing relations of hydrostratigraphic units identified in this report.

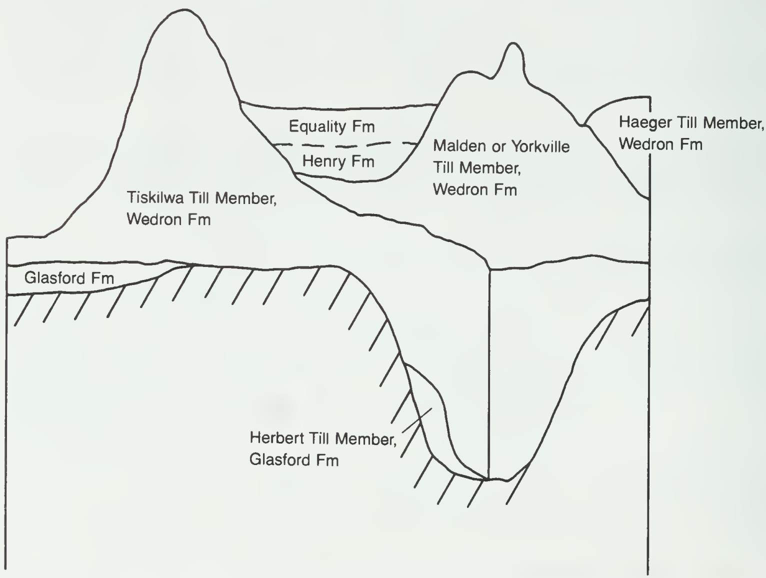

Figure 11b Schematic diagram showing relations of glacial drift units identified in this report.

Table 2 Hydrostratigraphic hierarchy in Kane County.

Aquigroup	*Aquiformation*	*Aquimember*
Prairie	Valparaiso aquifer	
	Elburn aquiformation	Kaneville aquifer member
	Bloomington aquifer	
	Pingree Grove aquiformation	
	Marengo aquitard	
	St. Charles aquifer	

Hydrostratigraphy

Hydrostratigraphy is the classification and mapping of significant units of rock with respect to distinctive porosity and permeability. It provides a framework within which to evaluate flow systems--whether the flow system is statewide or larger (regional), countywide (intermediate), or local. A hydrostratigraphic unit, which may occur in one or more material rock units, is unified and delimited by its hydrologic characteristics and interstices or voids. They are defined by the number, size, shape, arrangement and interconnection of the interstices, and recognized on the basis of the nature, extent, and magnitude of the interstices in any body of sedimentary, metamorphic, or igneous rock. Concepts of hydrostratigraphy are reviewed in Seaber (1988), and practical applications are presented in Visocky, Sherrill, and Cartwright (1985).

The hierarchy of hydrostratigraphic units, in order of decreasing rank, is aquigroup, aquiformation, aquimember, and aquibed. The fundamental unit of hydrostratigraphic classification is the aquiformation. One criteria of aquiformation is that it be mappable at the scale in the area where the aquiformation is defined. Table 2 shows the relations of the various divisions or hierarchy of hydrostratigraphic units used in this report.

Informal hydrostratigraphic names are used for aquiformations (such as the St. Charles aquifer; table 2, fig. 11a), which are subdivisions of aquigroups. Aquigroups and aquiformations are part of the concept of hydrostratigraphic units. Aquigroups are large bodies of rock distinguished by porosity and permeability, as well as by lithology, from overlying and underlying rock groupings. Aquiformations, which are equivalent to formations in geologic mapping, are the fundamental units of hydrogeologic mapping. Hydrostratigraphic units were formally defined for the area by Visocky, Sherrill, and Cartwright (1985).

The Prairie and Upper Bedrock Aquigroups provide the shallow groundwater resources for Kane County (fig. 6). As figures 11a and 11b show, the physical relations of hydrostratigraphic and glacial drift units may be complex. Both horizontal and vertical distribution must be used for proper aquifer assessment. The relationship of the glacial units, which are lithostratigraphic in nature, and the hydrostratigraphic units, which are dependent upon porosity and permeability, must be carefully detailed.

Upper Bedrock Aquigroup

The Upper Bedrock Aquigroup consists of local and intermediate flow systems in indurated sediments with open connection to the glacial drift that composes the Prairie Aquigroup. The rocks are of Ordovician and Silurian age. The most significant and productive aquifer is the Silurian dolomite aquifer or shallow dolomite aquifer (fig. 7), which is most productive in the eastern half of Kane County where this resource sustains pumping rates as great as 100 to 200 gpm (Visocky, Sherrill, and Cartwright, 1985). In these areas, large yields are sometimes obtained, reducing the dependence on the deeper aquifers. Most of the water is obtained in the uppermost 100 feet of rock; however, it is difficult to predict where the fractured and

vuggy bedrock occurs. The most productive wells constructed in the drift likely will be those that take advantage of buried bedrock valleys with sand and gravel aquifers that are hydrologically connected to fractured bedrock.

Prairie Aquigroup

Prairie Aquigroup deposits are Quaternary in age; most are late Pleistocene deposits of Wisconsinan age. In Kane County, the Prairie Aquigroup has local and intermediate flow systems in noncemented geologic materials—glacial drift, alluvium, and other Holocene sediments. The aquifers are confined locally by fine-grained sediments. Recharge to the system is mainly from local precipitation. The aquifers shown on figure 2 and plate 1 are at least 50 feet thick, whereas the actual hydrostratigraphic units have greater areal extent.

Visocky, Sherrill, and Cartwright (1985) provided a framework for bedrock hydrostratigraphy and named the Upper Bedrock Aquigroup; they also named the Prairie Aquigroup as the hydrostratigraphic unit composed of glacial drift. However, no previous reports describe or define subunits, such as aquiformations or aquimembers within the Prairie Aquigroup. Kane County is geographically unique in that several regionally important aquifers lie within the drift. The areas of relative potential for groundwater development in the Prairie Aquigroup, where the units are more than 50 feet thick, are shown on figure 2 and plate 1.

St. Charles aquifer Composed chiefly of stratified to massive sand and gravel deposits up to 120 feet thick, the St. Charles aquifer also includes beds of diamicton. A continuous aquifer thickness of 50 feet is maintained to about 3,000 feet laterally across the buried bedrock valleys; the continuity may be interrupted by restricted deposits of till or other non-water-yielding materials (figs. 12 and 13). The St. Charles aquifer is composed chiefly of sand and gravel facies of the Wedron and the Glasford Formations. The distribution of the St. Charles aquifer, where it exceeds 50 feet in thickness, is shown along with other glacial drift (Prairie Aquigroup) aquifers on plate 1. The vertical relation of the St. Charles aquifer to other Prairie Aquigroup members is shown in several cross sections (figs. 12 and 13). The large vertical exaggeration of these cross sections highlights the relations between units.

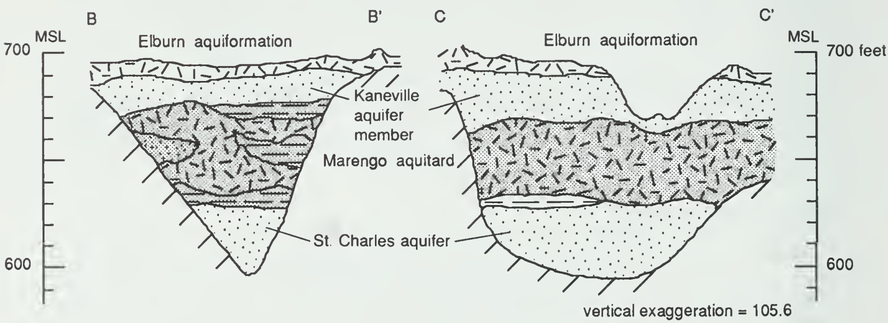

Figure 12 Cross sections of Aurora bedrock valley. Section lines B-B' and C-C' are located on figure 2 and plate 1.

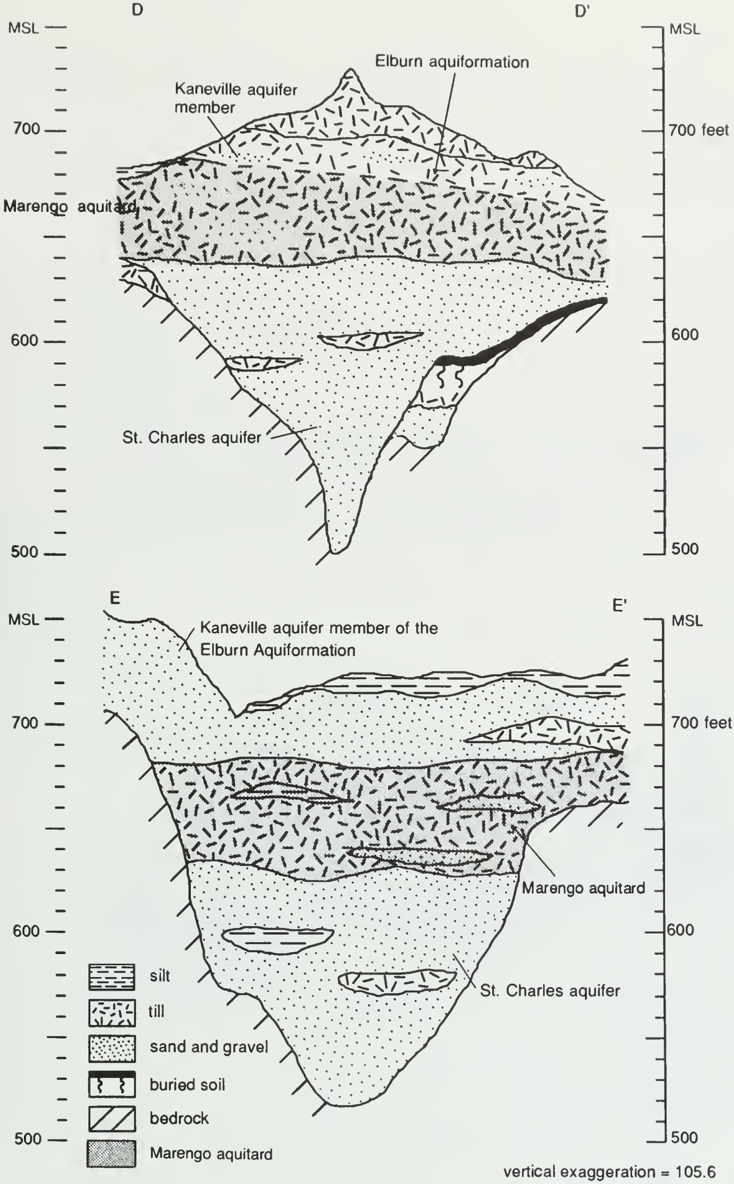

Figure 13 Cross sections of the St. Charles bedrock valley. Section lines D-D' and E-E' are located on figure 2 and plate 1. The Marengo aquitard is shaded.

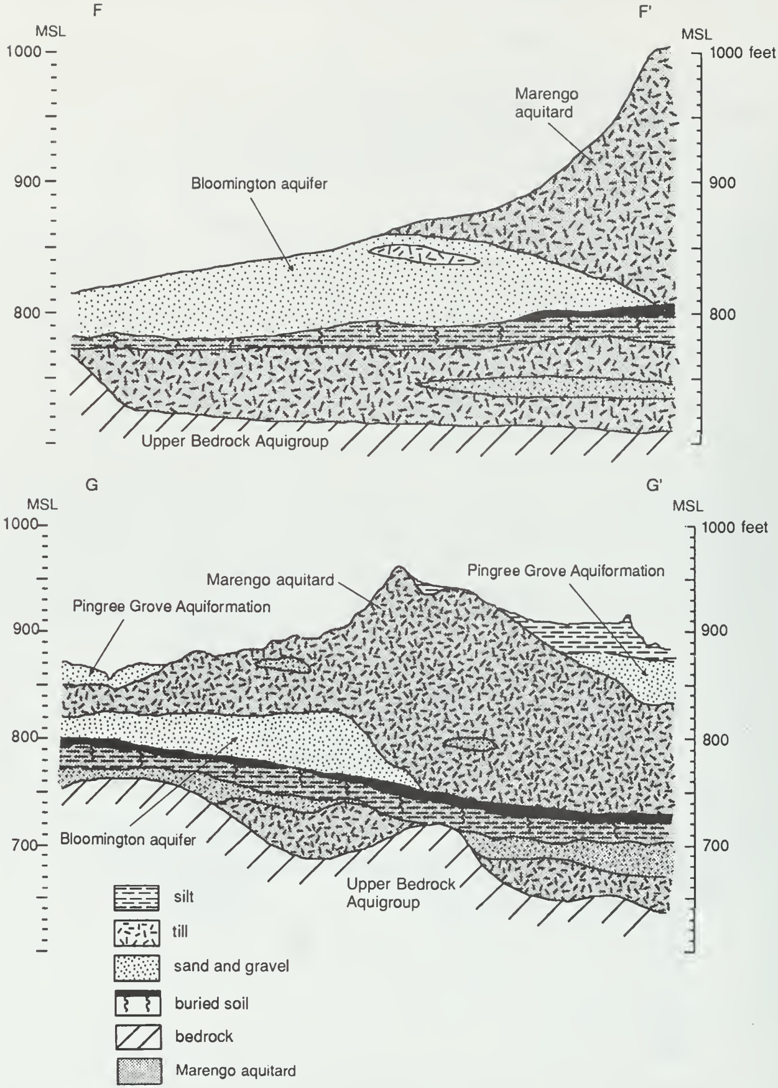

Figure 14 Cross sections showing the Marengo aquitard in relation to the Bloomington aquifer.

Marengo aquitard As much as 300 feet thick beneath the Marengo moraine, the Marengo aquitard covers the St. Charles aquifer in much of Kane County (fig. 12 and 13). The aquitard is chiefly made up of diamicton in the Tiskilwa Till Member of the Wedron Formation (Wickham, Johnson, and Glass, 1988). This facies is predominantly composed of pinkish, massive loam diamicton (till). The Marengo aquitard has a field-measured hydraulic conductivity on the order of 10^{-6} and 10^{-8} cm/sec (Jennings, 1987). Relatively small bodies of sand and gravel have been sporadically found in the Marengo aquitard, but these supply only small, local groundwater supplies for households.

Pingree Grove aquiformation This unit is composed of stratified sands, silt, clay, marl, and peat; it underlies present lakes, rivers, and streams. The aquiformation is thickest and most widespread beneath former lakes, most of which have naturally dried up or been drained for agriculture. The Pingree Grove aquiformation is as much as 50 feet thick on the north of Kane County, where the lower portion is commonly composed of sorted sands (Wickham, Johnson, and Glass, 1988) that may have limited potential as aquifers for households. Most commonly, however, the Pingree Grove is less than 20 feet thick and should not be considered an aquifer for large municipal, agricultural, and industrial supplies; thus it is not shown on figure 2 and plate 1. The Pingree Grove aquiformation is composed of the Equality Formation, Greyslake Peat, and Cahokia Alluvium.

Bloomington aquifer Located west of the Marengo ridge or moraine, the Bloomington aquifer is a surficial deposit or locally buried by the Marengo aquitard (fig. 14). It does not necessarily occur in the buried bedrock valleys. The deposit is composed of very poorly sorted gravelly sand generally less than 50 feet thick, and becomes thinner and finer grained to the west. The water quality and yield characteristics of this aquifer have not been tested. The Bloomington aquifer is composed of the Henry Formation and the sand and gravel facies of the Tiskilwa Till Member of the Wedron Formation. North of Kane County, the Bloomington aquifer merges with the Valparaiso aquifer.

Elburn aquiformation This unit, which underlies most of central and south-central Kane County, is primarily an aquitard (chiefly diamicton, but also lacustrine deposits); it also contains mappable bodies of sand and gravel that can be considered aquifers. Thus the Elburn is designated an aquiformation rather than an aquifer or aquitard.

The Kaneville aquifer member of the Elburn aquiformation represents a mappable body of rock that is an aquifer but is thought to be limited in extent and somewhat discontinuous. The Kaneville aquifer member is as much as 100 feet thick and overlies the St. Charles aquifer in the Sugar Grove and Montgomery areas (fig. 13). The Elburn aquiformation is composed of parts of several lithostratigraphic units, including the Henry Formation, and the Malden and Yorkville Till Members of the Wedron Formation.

Valparaiso aquifer Currently the most productive drift aquifer in Kane County (Appendix 4-5), the Valparaiso aquifer is the least extensive areally (plate 1, fig. 2). It is located immediately below ground surface on the northeast of Kane County; it is more extensive east and north of the county. The aquifer is more than 100 feet thick and composed of sand and gravel that becomes thinner and finer grained to the west (Fraser and Cobb, 1982; Hansel, Masters, and Socha, 1985). Significant reserves have been removed as sand and gravel aggregate (Masters, 1978). In Kane County, the Valparaiso aquifer is composed of the Henry Formation and Haeger Till Member of the Wedron Formation.

SUMMARY OF FINDINGS OF THE INVESTIGATION

Conditions are favorable for development of shallow groundwater resources for public, industrial, and agricultural supplies in Kane County. In this report, the Illinois State

Geological Survey defined and described hydrogeologic units within the Prairie Aquigroup and Upper Bedrock Aquigroup, both hydrostratigraphic groupings. Aquiformations, or mappable hydrogeologic units, were defined for the first time for the Prairie Aquigroup. The areas with the best potential for groundwater development in the glacial drift are shown on figure 2 and plate 1. The entire extent of the hydrostratigraphic units is not shown on figure 2 and plate 1, but only those areas where the thickness of the aquifers exceeds 50 feet. These are the most favorable areas for the development of municipal, industrial, and agricultural supplies of water because an aquifer with a thickness of 50 feet or more will produce the largest yields to individual wells and well fields.

"How much groundwater is available?" is a reasonable question frequently raised by local officials charged with the task of managing groundwater resources (Illinois Technical Advisory Committee on Water Resources, 1967). The resource lends itself to quantitative assessment (U.S. Water Resources Council, 1973). However, groundwater reservoirs are dynamic in nature; their withdrawal rates and patterns of extraction can be managed. Therefore, the development of the resource is subject to alternative plans, which may differ in their effects on yield potential, longevity of the supply, cost of recovery, impacts on other groundwater reservoirs or interconnection with surface water, and water quality.

The Illinois State Water Survey is preparing a separate report on the water quality and potential yield of these hydrostratigraphic units. The Illinois State Geological and State Water Surveys are also preparing reports on several communities in Kane County. Only when these reports are completed can the groundwater resources of Kane County be evaluated comprehensively.

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Table A1 Water quality summary from wells in Prairie Aquigroup in Kane County

Well	Owner	Depth (ft.)	Date	Alkalinity	Calcium	Chloride	Hardness	Iron	Magnesium	Potassium	Sodium	Sulfate	Total Dissolved Minerals
38N7E-21.5e	Sugar Grove #2	107	02/17/76	346	113	87	528	0.00	60	3.0	30	120	642
-24.6h	Aurora #101	116	10/22/87	341	65.2	8.1	314	0.62	36.8	-	6.9	9.9	363
38N8E-18.8b	Aurora TW10-84	125	12/20/85	280	85.8	20	389	2.22	42.6	-	6.4	-	445
-31.7a	Montgomery #7	46	08/16/76	336	105	35	470	0.00	45	5.6	14	96	526
-33.4h	Montgomery #10	82	01/05/87	345	122	77	525	2.51	53.6	2.4	33.2	99	592
-33.5h	Montgomery #11	59	09/09/87	348	101	101	508	<0.09	58.4	2.8	32.8	92.2	612
39N7E- 5.8f	Elburn #2	153	07/12/78	306	44	1.4	198	1.80	24.0	1.8	52	14	328
39N8E- 5.8a	Geneva #8	150	06/27/86	292	87	14	402	2.93	45	-	4.8	97est	461
40N6E-30.7a	Maple Park #3	182	03/25/80	285	46	1.0	217	0.70	29.0	3.1	24	10	294
-31.7h	Maple Park #2	134	05/25/82	344	71	2.7	305	2.30	38.6	1.7	13	10	385
40N7E-16.3c	Ferson Creek #3	175	11/03/82	380	84	6.8	368	1.80	43.0	1.6	17	29	429
-16.4c	Ferson Creek #2	186	05/12/75	348	60	3	271	1.30	29	1.7	32	4	398
40N8E-11.2f	Valley View #1	131	02/22/78	316	80	6.0	375	1.50	42.0	1.2	6.0	65	426
-11.4c	St. Charles Skyline #1	131	11/02/82	336	86	7.5	428	1.70	47.0	1.7	5.0	82	443
-11.7b	St. Charles Skyline #2	135	11/02/82	356	89	6.4	453	1.60	47.7	1.9	5.0	82	486
-15.2a	St. Charles #9	86	08/24/82	293	84	30.0	360	0.005	40.0	2.8	15.0	57	428
-28.8a	St. Charles #7	173	03/31/75	292	84	14	398	2.10	45	1.1	6	99	404
41N6E- 9.1g	8urlington #1	108	08/06/47	-	-	-	338	3.10	-	-	-	-	385
41N8E-14.3f	Elgin N. State St.	43	12/11/73	344	102	75	452	0.00	48	3.9	37	98	606
-26.2e	South Elgin #5	68	12/01/82	342	108	70	456	0.70	51.6	3.3	33	109	603
-34.1h	South Elgin #4	109	06/14/77	314	85	12	419	0.00	42	1.3	6	79	418
42N8E-14.2g	Carpentersville #6	179	03/09/77	332	85	15	430	1.40	48	1.6	4	67	461
-14.2h	Carpentersville #5	183	09/13/83	302	92	54	417	1.80	51.0	1.7	5.0	72	460
-14.7g	Lake Marian #3	75	03/18/80	331	93	13	389	1.70	46.0	1.4	4.0	60	454
-15.1f	Carpentersville #3	72	09/13/83	340	99	32	455	1.90	51	2.1	11	82	508
-22.28	West Oundee #2	87	02/03/72	304	94	25	416	0.00	46	3.4	15	102	486
-23.6d	East Oundee Spring	-	12/18/74	267	78	48	351	0.00	38	2.2	25	58	430
-23.6e	East Oundee #3	128	04/06/82	336	84	36	379	0.30	43.5	2.3	16	47	473
-28.6f	Sleepy Hollow #1	34	04/25/77	380	116	82	510	2.30	50	1.6	31	65	561
-28.6f	Sleepy Hollow #2	44	10/20/80	410	130	100	503	2.50	56	2.2	43	85	671

Table A2 Water quality summary from wells in Upper Bedrock Aquigroup in Kane County

Well	Owner	Depth (ft.)	Aquifer	Date	Alkalinity	Calcium	Chloride	Hardness	Iron	Magnesium	Potassium	Sodium	Sulfate	Total Dissolved Minerals
38N6E-26.2h	Moecherville Sbd. #3	196	Silurian	04/21/76	325	66	2.9	337	1.10	42	2.5	27	69	463
38N7E-10.2b	Prestbury Sbd. #1	200	Maquoketa	05/18/76	362	110	11	476	2.20	49	1.3	7.8	120	558
38N8E-24.4e	Ogden Gardens Sbd. #3	185	Silurian	02/24/76	272	55	2	270	0.90	32	2.5	28	58	340
-25.8g	Wermes Sbd. #2	253	Silurian	08/07/74	320	30	4	141	0.40	16	6.3	126	108	540
-31.7a	Montgomery #6	160	Sil/Maq	12/23/75	324	94	29	428	7.30	47	2.2	24	110	484
-34.8g	Bangs-Union-Parker #1	173	Maquoketa	03/02/76	344	55	15	279	1.25	34	6	89	130	550
-35.2g	Park View Wtr Corp. #1	250	Sil/Maq	03/76	332	73	3	350	1.40	41	1.5	12	49	390
-35.6b	Montgomery #5	186	Sil/Maq	01/21/72	304	96	16	452	0.00	50	1.2	10	131	557
-35.7d	Marviray Manor Sbd. #1	300	Sil/Maq	03/09/76	350	91	15	442	0.70	52	5.0	34	152	590
40N8E- 9.1c	River Grange Lakes #1	180	Sil/Maq	03/76	332	71	3	359	1.35	44	1.5	12	34	380
-15.4a	Highland Sbd. #1	152	Maquoketa	03/23/76	266	48	10	222	0.00	25	2.0	64	60	420
41N8E-28.1a	Elgin Lakes Bd. #1	300	Sil/Maq	02/12/76	346	89	15	409	0.85	45	1	8	80	470
42N8E-11.6d	Lake Marian Sbd. #2	251	Maquoketa	07/15/77	328	73	5	357	1.40	42	1.9	4	48	400

Table A3 Water quality summary from wells in Midwest Bedrock Aquigroup in Kane County

Well	Owner	Depth (ft.)	Aquifer*	Date	Alkalinity	Calcium	Chloride	Hardness	Iron	Magnesium	Potassium	Sodium	Sulfate	Total Dissolved Minerals
38N8E- 4.8d	North Aurora #4	1325	CO(-GP)	02/18/76	286	55	5.8	232	0.2	23	13	30	30	348
- 8.3e	Aurora #25	1460	CO(-GP)	06/14/77	280	58	10	248	0.1	25	14.4	34	49	376
-34.6b	Montgomery #8	1378	CO(-GP)	07/15/75	278	60.8	10	244	Tr.	22.5	15.2	32	40.9	353
39N8E- 9.8h	Geneva #6	1350	IG	01/18/72	284	59	3.8	256	0.0	26	10.4	13	9	304
-11.7e	Illinois Youth Center -Geneva #4	2001	CO(-GP)/EMS	02/28/72	248	53	10	220	0.1	20.5	12	28	21	376
-23.8f	Batavia #4	1357	CO	07/17/75	284	59.6	6	254	0.1	25.7	14.8	32.3	38.9	352
40N7E-16.6e	Ferson Cr. Sbd. #1	1409	CO	04/05/74	300	49.6	2	212	Tr.	21.4	10.5	41	5.1	325
40N8E-27.5a	St. Charles #3	1191	CO(-GP)	04/25/77	297	61	11	259	0.2	24	12.1	22	7	344
-31.7f	Illinois Youth Center -St. Charles #5	1292	CO(-GP)	02/16/72	288	61	4	252	0.0	25	9	18	8	320
41N6E- 9.1g	Burlington #2	1105	GP/A	02/17/76	312	64	1.5	283	0.2	30	6.6	9	0.0	304
41N8E-16.4d	Elgin #3A	1378	CO	11/15/76	296	64	40	262	0.0	25	9.9	37	0.0	353
42N8E-27.1e	West Dundee #1	1239	CO(-GP)	02/17/76	291	59	2.3	242	0.1	23	9.6	18	2	329

CO - Aquifers of the Cambrian and Ordovician Systems
(-GP) - not open to Galena-Platteville Unit
GP/StP - Galena-Platteville Unit/Ancell aquifer
IG - Ironton-Galesville aquifer
EMS - Elmhurst-Mt. Simon aquifer

Table A4 Summary of principal aquifer hydraulic properties from aquifer tests and specific capacity analysis in Kane County

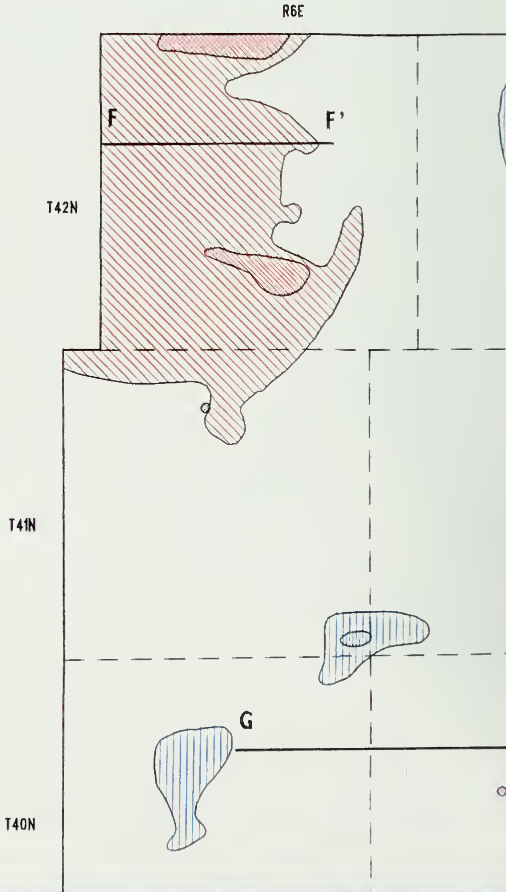
Well	Owner	Depth (ft)	Date of test	Length of test (hrs)	Pumping rate (gpm)	Nonpumping water level (ft)	Specific capacity (gpm/ft)	Transmissivity (gpd/ft)	Hydraulic conductivity (gpd/sq ft)	Storage coefficient	Analysis*	Land elevation (msl)	Hydrostratigraphic unit
38N7E-21.4e	Sugar Grove #1	104	04/48	4.7	106	49.6	18.3	20,000	370	Water Table	S	727	Kaneville
-21.5e	Sugar Grove #2	107	06/61	5.6	517	48.5	79.5	105,000	1,580	Water Table	S	727	Kaneville
-21.5e	Sugar Grove #3	110	02/61	12.0	220	48.5	44.0	60,000	976	Water Table	S	727	Kaneville
-24.6h	Aurora #101	116	12/70	24.0	810	2.0	13.0	25,450	592	Artesian	T	672	St. Charles
-24.6h	Aurora #101	116	10/87	359	651	4.5	12.8	19,100	424	0.00080	T	672	St. Charles
-31.1a	Aurora TW3-71	130	02/71	24.0	503	22.1	24.8	98,000	1,660	0.00076	T	690	St. Charles
-33.7d	State Water Survey TW1	77	10/70	20.5	421	8.0	33.7	90,000	1,730	0.00053	T	665	Keneville
38N8E-18.8b	Aurora TH10-84	125	12/86	24.0	1026	5.3	28.9	52,170	510	0.00035	T	675	St. Charles
-31.7a	Blackberry Hts.Sbd.#2	46	07/60	8.0	230	15.0	19.2	23,000	742	Water Table	S	665	Elburn
-33.4h	Montgomery #10	82	12/86-01/87	665	608	20.47	21.9	29,420	680	0.1 **	T	637	St. Charles
-33.5h	Montgomery #11	59	09/87	191	393	3.7	15.7	28,086	395	0.026 **	T	621	St. Charles
-34.8g	Aurora #116	61	04/88	168	399	17.2	20.4	23,710	525	0.097	T	655	St. Charles
39N6E-25.4g	Elmhurst Chicago Stone	125	05/71	4.0	1250	38.0	96.2	220,000	4,680	Artesian	S	790	Kaneville
39N7E- 5.8f	Elburn #2	153	03/37	9.0	75	85.0	1.2	1,150	68	Water Table	S	850	Marengo
-20.4d	Blackberry Ctr TW-1	110	08/74	120	1300	9.0	67.6	59,600	1,360	0.0009	T	750	Kaneville
39N8E- 5.8a	Geneva #8	150	06/86	72	1513	46.8	66.3	262,000	2,749	0.00034	T	765	St. Charles
40N6E-30.7a	Maple Park #3	182	05/71	7.0	80	17.8	0.76	1,187	17	Artesian	T	862	Marengo
-31.7h	Maple Park #2	134	10/46	3.5	132	19.0	1.55	2,800	34	Artesian	S	865	Marengo
40N7E-16.3c	Ferson Creek #3	175	10/78	4.3	254	23.0	8.47	17,000	-	Artesian?	S	840	Marengo
-16.4c	Ferson Creek #2	186	02/75	24	285	69.0	2.91	6,200	-	Artesian?	S	850	Marengo
40N8E-11.2f	Valley View #1	128	08/74	8.0	244	95.0	17.4	21,000	636	Water Table	S	784	Kaneville/St. Charles
-11.7b	St. Charles Skyline #1	131	08/58	8.0	250	100.5	27.8	35,000	1,060	Water Table	S	787	Kaneville
-11.7b	St. Charles Skyline #2	135	06/69	8.0	346	102	21.6	26,000	788	Water Table	S	787	Kaneville
-12.1e	Polioka Farm	238	/61	-	50	93.0	5.0	9,000	-	Artesian?	S	930	Elburn
-15.2a	St. Charles #9	86	12/79	24.0	1585	19.5	186	435,900	6,554	Water Table	T	705	St. Charles
-28.8a	St. Charles #7	173	11/63	2.0	1005	59.0	251.3	350,000	4,730	Water Table	S	765	St. Charles
41N6E- 9.1g	Burlington #1	108	07/41	3.0	41	33.0	8.2	16,000	640	Artesian?	S	925	Marengo
41N8E-11.7g	Elgin Slade Ave.	52.9	05/70	-	289	9.7	11.4	12,000	-	Water Table?	S	725	Elburn
-14.3f	Elgin North State St.	43	/34	0.3	84	25.0	60.0	55,000	3,667	Water Table	S	730	Elburn
-14.3g	W.R. Meadows, Inc. #3	30	08/63	3.3	80	12.8	17.1	18,500	1,076	Water Table	S	710	Elburn
-14.7d	Elgin Crighton Ave.	48.6	06/48	12.0	200	14.0	20.0	25,000	860	Water Table?	S	795	Elburn
-26.2e	Kerber Packing	68	06/59	8.1	1284	8.0	80.25	110,000	1,780	Water Table	S	705	St. Charles
-34.1h	South Elgin #4	109	10/83	5.6	517	66.0	79.5	105,000	2,442	Water Table	S	762	Keneville
-35.3a	South Elgin #2	117	04/52	3.1	257	28.8	8.4	16,500	750	Artesian	S	705	St. Charles
-35.3c	South Elgin #3	112	04/62	4.6	402	37.0	7.1	14,000	875	Artesian	S	735	St. Charles
42N8E-14.2f	Meadowdale Sbd. #4	177	02/57	8.0	1100	69.0	100	250,000	10,000	Artesian	S	860	Valporaiso
-14.2g	Carpentersville #6	179	04/73	4.0	3150	104	242	580,000	8,900	Artesian	S	880	Valporaiso
-14.2h	Carpentersville #5	183	01/73	4.0	3016	112.5	287	690,000	13,000	Artesian	S	875	Valporaiso
-15.1f	Meadowdale Sbd. #3	72	10/55	8.0	1223	18.0	58.2	150,000	3,750	Artesian	S	790	Valporaiso
-16	Meadowdale Raceway	54.5	07/58	4.0	33.5	39.0	13.4	14,500	935	Water Table	S	890	Elburn
-22.2b	West Dundee #2	87	02/69	20.0	495	51.0	49.5	72,000	2,000	Water Table	S	760	Elburn
-23.6e	East Dundee #3	128	04/69	8.0	1033	59.2	31.7	70,000	2,190	Artesian	S	830	Valporaiso
-23.7d	East Dundee #2	68.8	12/58	6.0	759	37.0	84.3	115,000	4,600	Water Table	S	785	Valporaiso
-28.6f	Sleepy Hollow #1	34	10/59	0.3	280	0.2	20.9	16,000	615	Water Table	S	747	Kaneville

* S - Specific capacity analysis
T - Time-drawndown analysis
** - Long-term storage coefficient (water table)

Table A-5 Mean and sample standard deviation of water quality data from the Prairie Aquigroup, Upper Bedrock Aquigroup, and Midwest Bedrock Aquigroup in Kane County (μg/l)

Aquifer (no. analyses)	Alkalinity	Ca^{++}	Cl^{-}	Hard-ness	Fe^{++}, Fe^{+++}	Mg^{++}	K^{+}	Na^{+}	SO_4^{--}	TDS	Ba^{++}
Prairie Aquigroup (29)	329.2± 32.3	88.7± 19.9	33.9± 32.5	400.8± 83.7	1.3± 1.0	44.8± 8.3	2.3± 1.0	18.4± 13.7	67.5± 33.9	472.6± 93.3	0.1± 0.1
Upper Bedrock Aquifer (13)	323.5± 28.3	73.2± 22.5	10.1± 7.9	347.8± 98.3	1.5± 1.9	39.9± 10.5	2.7± 1.8	34.3± 36.9	88.4± 38.5	472.5± 81.6	0.0± 0.1
Midwest Bedrock Aquigroup (12)	287.0± 15.6	58.7± 4.3	8.9± 10.4	247.0± 19.2	0.1± 0.1	24.3± 2.5	11.5± 2.6	26.2± 10.0	17.6± 17.7	340.3± 24.3	1.8± 3.0

AQUIFERS WITH P
OF PUBLIC WATER
IN KANE



AQUIFERS WITH POTENTIAL FOR DEVELOPMENT OF PUBLIC WATER SUPPLIES: PRAIRIE AQUIGROUP IN KANE COUNTY, ILLINOIS